



# Commercial Orbital Transportation Services (COTS) Demonstrations

**AIAA Space 2006**

**September 20, 2006  
San Jose, CA**

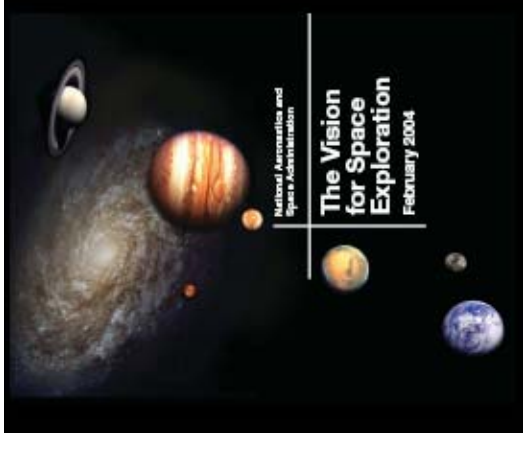
**Alan Lindenmoyer**  
Manager, Commercial Crew & Cargo Program Office  
Exploration Systems Mission Directorate  
Johnson Space Center

National Aeronautics and Space Administration

# National Direction



- **National Space Exploration Policy/  
Vision for Space Exploration, Jan 2004**
  - [The United States will] Promote... **commercial participation in exploration...** to further U.S. scientific, security, and economic interests.
  - [The NASA Administrator will] Pursue **commercial opportunities for providing transportation and other services supporting the International Space Station and exploration missions beyond low Earth orbit.**
- **NASA Authorization Act of 2005**
  - The Administrator shall establish a program to develop a sustained human presence on the Moon... **to promote exploration, science, commerce...**
  - The Administrator... **shall develop a commercialization plan** to support the human missions to the Moon and Mars, to support low-Earth orbit activities...
- **NASA Administrator Mike Griffin,  
American Astronautical Society, Nov. 15, 2005**
  - If we are to make the expansion and development of the space frontier an integral part of what it is that societies do, then these activities must, as quickly as possible, assume an economic dimension as well... To this end, it is up to us at NASA to use the challenge of the Vision for Space Exploration to **foster the commercial opportunities** which are inherent to this exciting endeavor.



# NASA ISS Obligations

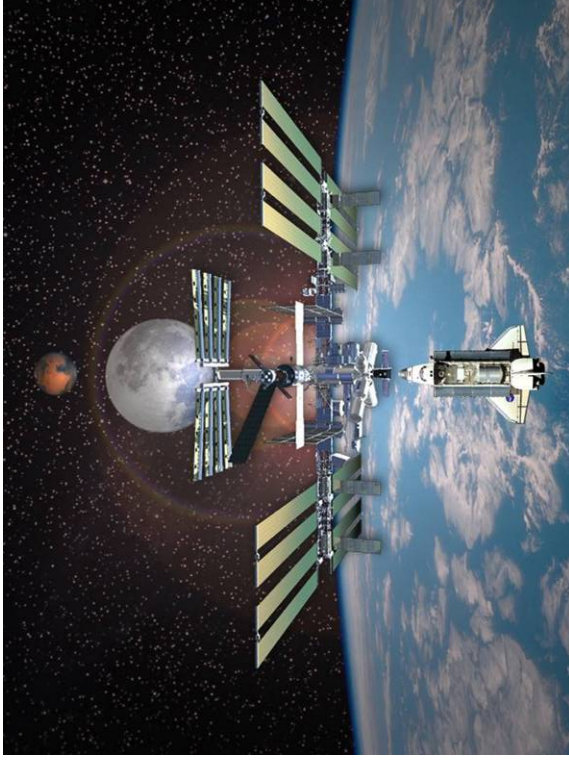


- **Need**
  - NASA has an immediate and long term obligation to service the International Space Station (ISS)
- **Status**
  - Vision for Space Exploration to retire Space Shuttle by 2010 results in using remaining flights for ISS assembly, plus one flight possibly for Hubble Space Telescope
  - Baseline barter and purchase agreements for International Partner space transportation capabilities (Progress, Soyuz, ATV, HTV) are no longer sufficient to meet projected ISS operational needs
  - There is a shortfall and gap in accommodating ISS resupply needs until CEV and cargo variants become available by 2014

- **Solutions**

**Commercial transportation services is the preferred approach if proven reliable and cost effective**

- CEV and foreign purchases of space transportation capabilities are alternatives to meeting service obligations to ISS if commercial services are unavailable



# Program Objectives



- The Commercial Crew & Cargo Program Office (C3PO) has been established at the Johnson Space Center to implement Phase I of the COTS Project
- The specific objectives are:
  - *Implement U.S. Space Exploration policy with an investment to stimulate commercial enterprises in space*
  - *Facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving reliable, cost effective access to low-Earth orbit*
  - *Create a market environment in which commercial space transportation services are available to Government and private sector customers*

# COTS Overview



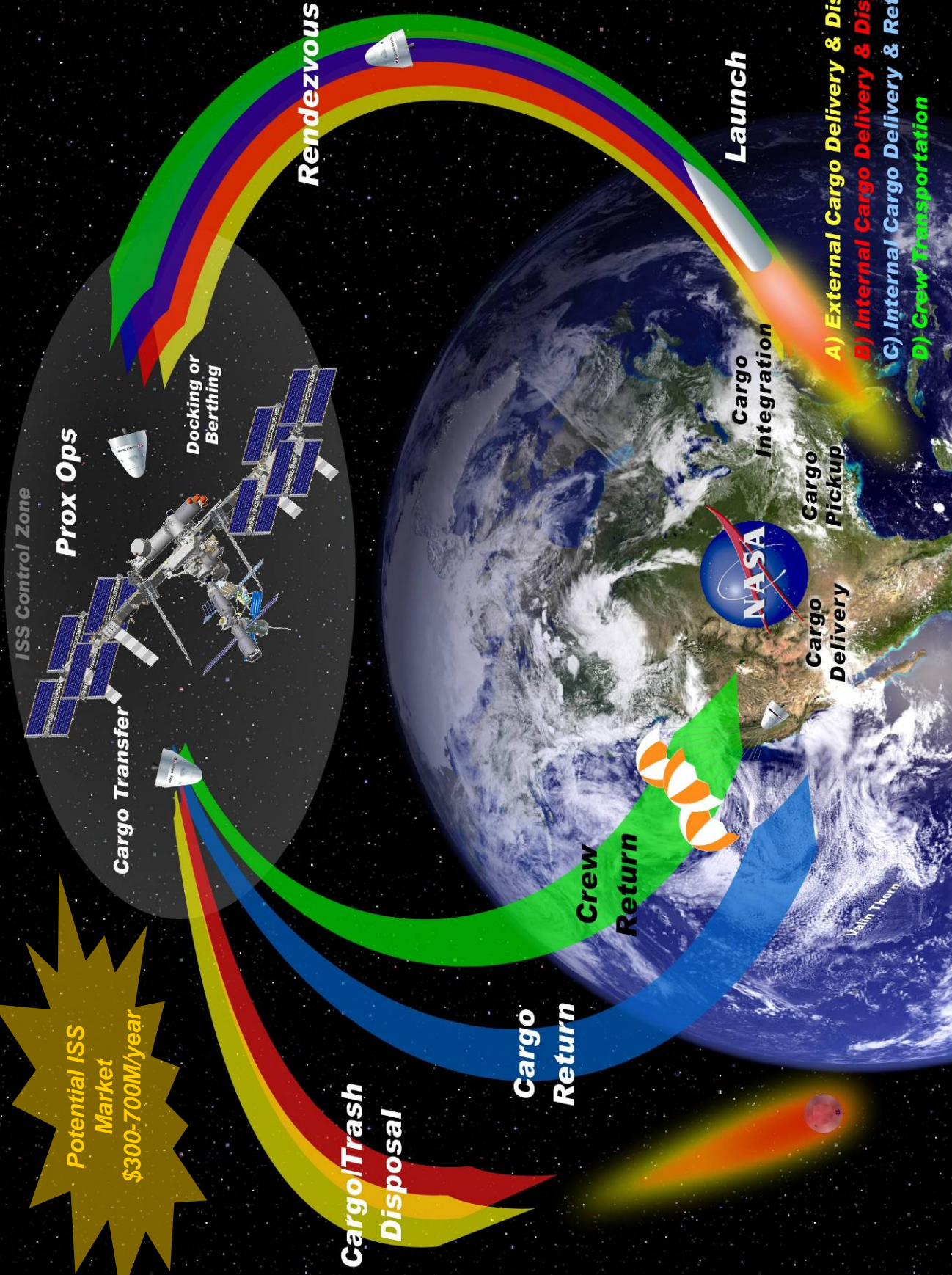
- \$500M budgeted in FY06-FY10 as **investment** for demonstration of commercial orbital transportation capabilities
- COTS Project executed in two phases:
  - Phase 1: Technical Development/Demonstration funded Space Act Agreements (SAA)
  - Phase 2: Competitive Procurement of Orbital Transportation Services
- Phase 1 competition executed Jan-Aug 2006
- Phase 1 SAAs include *option* for crew transportation demonstrations
  - Pending successful cargo demonstrations and additional NASA funding

***COTS Phase 1 is NOT a procurement or contract for products and services –  
It is NASA's catalyst for technology demonstrations where the potential high  
return on investment outweighs the associated financial risk***



# Commercial Orbital Transportation Services

Potential ISS  
Market  
\$300-700M/year



# Innovative Features



- **Phase 1 Competition**

- Utilize NASA's Space Act authority vs. FAR contract
- Emphasize management team skills vs. company past performance
- Business plan and financial criteria similar to private investment models
- Broadly targeted technical goals for the general space transportation market
  - Firm requirements/processes where necessary for ISS certification and human safety
- Encourage private investment to enable multiple awards and maximize coverage

- **Space Act Agreement**

- Companies retain maximum rights to intellectual and personal property allowed by law
- FAA licensing and cross-waiver liability provisions
- Fixed-price performance milestone payments
  - Series of incremental milestones based on objective criteria
- Restricted termination provisions



# COTS Participants

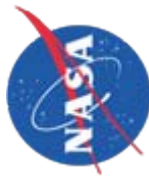
- Received 21 proposals from 20 companies across the full spectrum of industry
- Down selected to 6 companies for final evaluation and negotiations
  - Andrews Space
  - SpaceDev
  - SPACEHAB
  - Transformational Space Corp. (t/Space)
  - **Space Exploration Technologies (SpaceX)**
  - **Rocketplane-Kistler (RpK)**
- Discussions with COTS participants are ongoing for NASA technical assistance via potential unfunded SAAs

*Funded Space Act Agreement*

*Funded Space Act Agreement*



# SpaceX COTS Concept



## COMMERCIAL CREW & CARGO



### Description:

- Falcon 9 Launch Vehicle
- Dragon Crew/Cargo Spacecraft

### Proposed Features:

- Flexible crew and cargo configurations
- Recoverable launch vehicle and spacecraft
- Capability A/B/C demonstration planned for completion by September 2009
- NASA Investment:
  - Capabilities A/B/C - \$278 M
  - Capability D Option - \$308 M

# SPACEX

Space Exploration Technologies

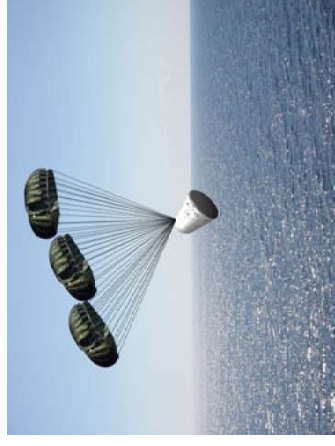
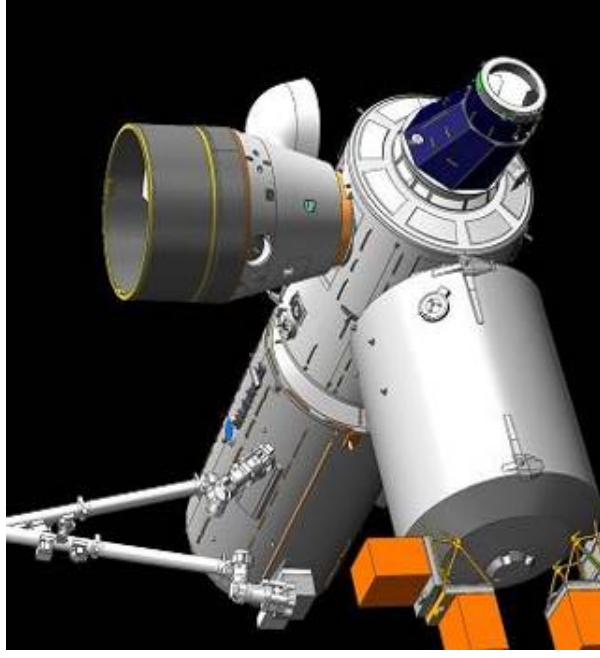


# SpaceX Milestone Highlights



## COMMERCIAL CREW & CARGO

- **FY06**
  - Program Management Plan/Kickoff
- **FY07**
  - System Requirements Review
  - Preliminary Requirements Review
  - Financing Round
  - Critical Design Review
- **FY08**
  - Financing Round
  - System/Design/Test/Readiness Reviews
  - Orbital Test Flight 1
- **FY09**
  - Delta System/Design/Test/Readiness Reviews
  - Orbital Test Flight 2
  - Orbital Demonstration Mission to ISS



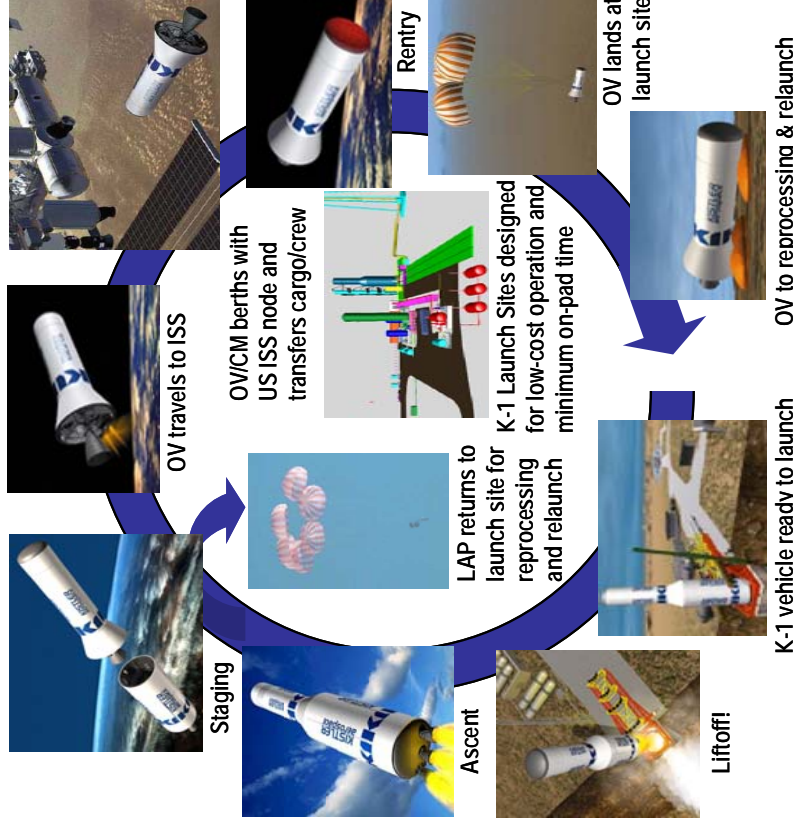
# Rocketplane Kistler COTS Concept



## COMMERCIAL CREW & CARGO

- Description:**
- K-1 Launch Vehicle
  - Orbital Vehicle
  - Pressurized/Unpressurized Cargo/Crew Modules

- Proposed Features:**
- Reusable launch and orbital vehicles that return to launch site
  - Modular crew and cargo configurations
  - Capability A/B/C demonstration planned for completion by March 2009
  - NASA Investment:
    - Capabilities A/B/C - \$207 M
    - Capability D Option - \$200 M



LOCKHEED MARTIN

Honeywell

NORTHROP GRUMMAN

Alenia  
SPAZIO  
A FINMECCANICA COMPANY

NSI

ATA  
ENGINEERING, INC.

OCEANEERING



Raytheon

PARAGON  
FACT DEVELOPMENT CORPORATION

AEROJET

DRAPER  
LABORATORY

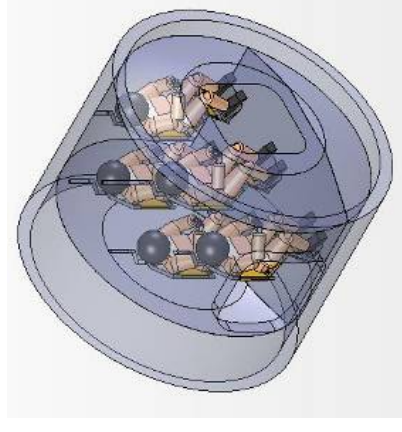
Orbital



# RpK Milestone Highlights

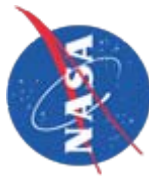
## COMMERCIAL CREW & CARGO

- **FY06**
  - Program Management Plan/Kickoff
  - Financing Round
- **FY07**
  - System Requirements Review
  - Financing Round
  - Critical Design Reviews
- **FY08**
  - Financing Round
  - System/Design/Test/Readiness Reviews
  - Launch Vehicle Complete/Ship
  - Certification of Flight Readiness
- **FY09**
  - Risk Reduction Orbital Test Flight
  - Orbital Demonstration Mission to ISS (internal/pressurized)
  - Orbital Demonstration Mission to ISS (external/unpressurized)

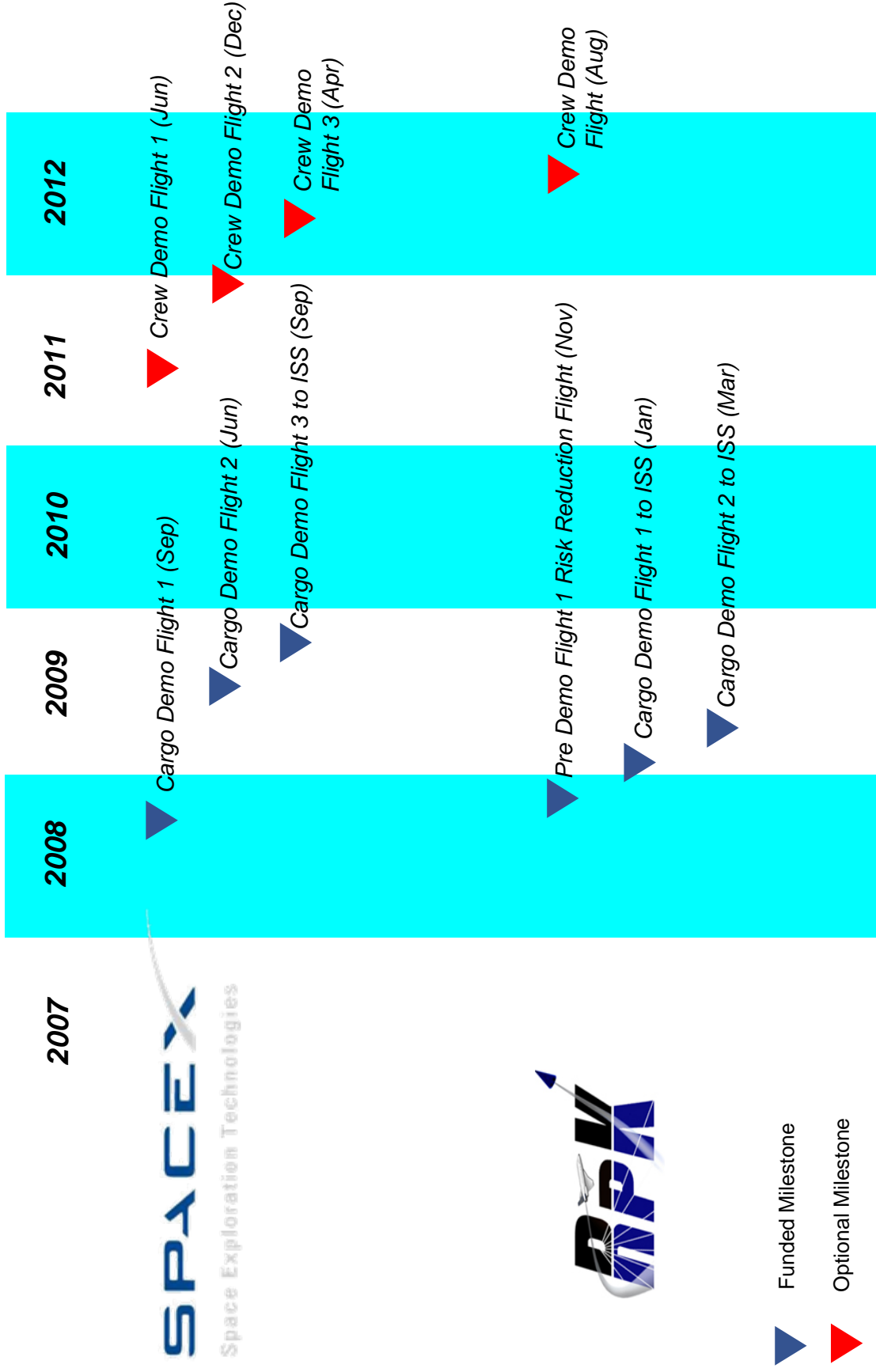




# COTS Flight Demonstrations

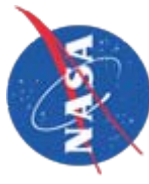


2007



▲ Funded Milestone

▲ Optional Milestone



# Summary

- U.S. space policy directs pursuit of commercial opportunities for providing transportation and other services low Earth orbit and beyond
- COTS Project established to implement policy
- COTS strategy
  - Phase 1 -- Assist industry with system development/demonstrations (COTS Demos)
  - Phase 2 -- Procure commercial services for ISS logistics support
- COTS Demonstrations completed in 10 months
- Two industry partners selected for funded Space Act Agreements
  - SpaceX & Rocketplane-Kistler
  - Unfunded Space Act Agreements in work with other competitors
- COTS budget of \$500 M thru 2010, with pay for performance milestone approach
- Cargo flight demonstrations planned for 2008 and 2009
  - Crew flight demonstration options for 2011-2012
- Commercial cargo transportation services potentially available as early as 2009-2010
- Successful COTS partners may open new space markets and provide reliable, cost effective cargo and crew transportation services - a new era for commercial space